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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
NASA-13960 (July 2003)  
NASA - KSC  
Superseding NASA-13960  
(June 2001)  
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07/03

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## SECTION 13960

### CARBON DIOXIDE EXTINGUISHING SYSTEMS 07/03

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NOTE: Delete, revise, or add to the text in this  
section to cover project requirements. Notes are  
for designer information and will not appear in the  
final project specification.

This section covers carbon dioxide fire-protection  
systems.

Indicate protected spaces and affected equipment on  
the drawings.

\*\*\*\*\*

#### PART 1 GENERAL

##### 1.1 REFERENCES

\*\*\*\*\*  
NOTE: The following references should not be  
manually edited except to add new references.  
References not used in the text will automatically  
be deleted from this section of the project  
specification.

\*\*\*\*\*

The publications listed below form a part of this section to the extent  
referenced:

#### ASME INTERNATIONAL (ASME)

ASME B36.10M (2000) Welded and Seamless Wrought Steel  
Pipe

#### ASTM INTERNATIONAL (ASTM)

ASTM A 106 (1999 e1) Standard Specification for  
Seamless Carbon Steel Pipe for  
High-Temperature Service

ASTM A 53 (2001) Standard Specification for Pipe,  
Steel, Black and Hot-Dipped, Zinc-Coated

Welded and Seamless

ASTM B 88 (1995) Standard Specification for Seamless  
Copper Water Tube

ASTM B 88M (1995) Standard Specification for Seamless  
Copper Water Tube (Metric)

MANUFACTURER'S STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS  
INDUSTRY (MSS)

MSS SP-58 (1993) Pipe Hangers and Supports -  
Materials, Design and Manufacture

MSS SP-69 (1996) Pipe Hangers and Supports -  
Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 12 (2000) Standard on Carbon Dioxide  
Extinguishing Systems

NFPA 72 (2002) National Fire Alarm Code

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES  
(NICET)

NICET 1032-12 (2003; 2nd Ed) Program Detail Manual  
Special Hazards Suppression Systems

UNDERWRITERS LABORATORIES (UL)

UL 536 (1997; 8th Ed) UL Standard for Safety  
Flexible Metallic Hose

1.2 SYSTEM DESCRIPTION

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**NOTE: If Section 15003, "General Mechanical  
Provisions," is not included in the project  
specification, applicable requirements therefrom  
should be inserted and the following paragraph  
deleted.**

\*\*\*\*\*

Section 15003, GENERAL MECHANICAL PROVISIONS, applies to work specified in  
this section.

1.2.1 Design Requirements

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**NOTE: Modify the following paragraph to suit  
project requirements.**

\*\*\*\*\*

Full consideration shall be given to built-in spaces, piping, electrical equipment, ductwork, and all other construction and equipment. System shall be free from operating and maintenance difficulties.

Devices and equipment shall be a make and type listed by the Underwriters Laboratories, Inc. (UL), or Factory Mutual (FM) approved. In the UL and FM publications, the advisory provisions shall be considered to be mandatory. Reference in publications to the "authority having jurisdiction" shall be interpreted to mean the Kennedy Space Center Fire Protection Engineer.

\*\*\*\*\*  
**NOTE: Select system type.**  
\*\*\*\*\*

System shall be an approved high-pressure carbon dioxide [hand] [hose] [reel] total flooding type system conforming to NFPA 12.

Electrical work associated with the system shall meet the requirements of the appropriate sections of Division 16, "Electrical," pertaining to fire detection.

Components used in the installation shall be new, unused and not be greater than one (1) year old from the date of manufacture.

\*\*\*\*\*  
**NOTE: Section 15072, "Vibration Isolation for Air Conditioning Equipment," may be used as a guide for vibration isolation.**  
\*\*\*\*\*

#### 1.2.2 Performance Requirements

\*\*\*\*\*  
**NOTE: Discharge of carbon dioxide into an enclosed space creates a dangerous oxygen deficiency for personnel. Dilution of oxygen in the air by the carbon dioxide concentrations necessary to extinguish the fire will create atmosphere that will not sustain life.**  
\*\*\*\*\*

Carbon dioxide shall be supplied from 50-, 75-, or 100-pound 25-, 40-, 50-kilogram high-pressure cylinders and shall be stored in rechargeable containers designed to hold pressurized carbon dioxide in liquid form at atmospheric temperatures corresponding to a normal pressure of 850 pounds per square inch (psi) at 70 degrees F 5860 kilopascal at 21 degrees C.

High-pressure cylinders shall be constructed, tested, and marked in accordance with U.S. Department of Transportation specifications for seamless steel cylinders.

Each cylinder shall be provided with a safety device to relieve excess pressure safely, in advance of the rated cylinder test pressure. Devices

shall be Interstate Commerce Commission approved frangible safety disks.

Carbon dioxide cylinders shall be supported by suitable racks attached to walls and floor. Cylinder framing shall be fitted with a weighing bar bracket, weight bar, and direct-reading scale to weigh cylinders in place without deactivating the system.

System shall be arranged for fully automatic, manually operated, and remote-pushbutton electric control operation. Operating controls shall be the enclosed release type to prevent accidental operation.

### 1.3 SUBMITTALS

\*\*\*\*\*  
NOTE: Review submittal description (SD) definitions in Section 01330, "Submittals," and edit the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control. Include a columnar list of appropriate products and tests beneath each submittal description.  
\*\*\*\*\*

The following shall be submitted in accordance with Section 01330, SUBMITTALS, in sufficient detail to show full compliance with the specification:

#### SD-02 Shop Drawings

Connection diagrams shall be submitted indicating the relations and connections of the following items. Drawings shall indicate the general physical layout of all controls, and internal tubing and wiring details.

Carbon Dioxide Cylinders  
Piping Materials  
Carbon Dioxide Control Panel

Installation Drawings and As-Built Drawings shall be submitted in accordance with paragraph entitled, "General," of this section.

#### SD-03 Product Data

Equipment Foundation Data shall be submitted in accordance with paragraph entitled, "General," of this section.

Manufacturers Catalog Data shall be submitted for approval for the following items:

Piping Materials  
High-Pressure Cylinders  
Escutcheons  
Supporting Elements

## Flexible Metallic Hoses

### SD-05 Design Data

Design Analysis and Calculations shall be submitted in accordance with paragraph entitled, "General," of this section.

### SD-06 Test Reports

Test reports shall be submitted for the following tests in accordance with the paragraph entitled, "Field Testing," of this section.

Pressure Tests  
System Tests

Request for Inspection and Test shall be submitted in accordance with paragraph entitled, "Preliminary Tests," of this section.

### SD-07 Certificates

Listing of Product Installation shall be submitted for carbon dioxide fire-protection systems in accordance with paragraph entitled, "Installation," of this section.

Certificates shall be submitted for the following items showing conformance with the referenced standards contained in this section.

Qualifications of Installer

### SD-08 Manufacturer's Instructions

Operating Instructions shall be submitted in accordance with paragraph entitled, "Operating Instructions," of this section.

### SD-10 Operation and Maintenance Data

Operation and Maintenance Manuals shall be submitted in accordance with paragraph entitled, "Operating Instructions," of this section.

## 1.4 GENERAL

Equipment Foundation Data shall be submitted for carbon dioxide fire-protection systems consisting of the following information:

Equipment weight and operating loads.

Horizontal and vertical loads.

Size, location, and projection of anchor bolts.

Horizontal and vertical clearances for installation, operation and maintenance.

Plan dimensions of foundations and relative elevations.

Installation requirements such as noise abatement, vibration isolation, and utility service.

Installation Drawings shall be submitted for carbon dioxide fire-protection systems in accordance with the requirements of NFPA 12. Drawings shall include details of equipment layout and design.

As-built drawings shall be submitted for approval 14 days prior to the acceptance testing phase of the project, as described in the paragraph entitled, "Field Testing" of this specification section. Two (2) sets of magnetic media and hard copies of all drawings shall be provided with the submittal. As-built drawings shall document final system configuration including deviations from and amendments to the drawings, and field installation changes, concealed and visible.

.DWG or .DGN format computer generated floor plan layouts indicating all system components shall be provided.

Design Analysis and Calculations shall be submitted for carbon dioxide fire-protection systems including spray areas, hazard by class, and pressure calculations.

## 1.5 QUALITY ASSURANCE

### 1.5.1 Qualifications of Installer

Qualifications of System Technician: Installation drawings, shop drawings and as-built drawings shall be prepared, by or under the supervision of, an individual who is experienced with the types of works specified herein, and is currently certified by the National Institute for Certification in Engineering Technologies NICET 1032-12 as an engineering technician with minimum Level-III certification in Special Hazard System program. Contractor shall submit data for approval showing the name and certification of all involved individuals with such qualifications at or prior to submittal of drawings.

## PART 2 PRODUCTS

### 2.1 EQUIPMENT

Only UL-listed or FM-approved equipment and devices shall be used in the systems.

System shall be designed and constructed to include a fixed supply of carbon dioxide cylinders connected to properly sized, fixed piping with fittings and nozzles to direct this agent into an enclosure surrounding the hazard.



## 2.2 COMPONENTS

### 2.2.1 Piping

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**NOTE: Revise the following paragraph to suit  
project requirements.**

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Manifolds and distribution piping materials shall be galvanized, ferrous piping, Schedule [40] [80], conforming to [ASTM A 53] [ASTM A 106] [ASME B36.10M]. Nonferrous drawn seamless copper tubing shall conform to ASTM B 88 ASTM B 88M. Flexible metallic hoses shall conform to UL 536.

Pipe sizes shall be reduced in the fitting. Flush bushings shall not be used. Brazed joints, when used, shall be fused with an alloy with a melting point above 1,000 degrees F 538 degrees C.

Pipe and fittings shall have a minimum bursting pressure of 5,000 psi 34.5 Megapascal. For 1/2-inch and 3/4-inch DN 15 and DN 20 iron pipe size (ips), the pipe shall be Schedule 40. For 1 inch DN 25 or greater, the pipe shall be Schedule 80. Standard malleable iron banded fittings or ductile iron fittings shall be used up through 3/4-inch DN 20 ips. Extra heavy malleable iron or ductile iron fittings shall be used through 2-inch DN 50 ips. Forged steel fittings shall be used in all sizes over 2 inches DN 50.

A dirt trap (leg) consisting of a tee with a capped nipple, at least 2 inches 50 millimeter long, shall be installed at the end of each pipe run.

Baffle-type nozzles shall be used for distribution in normal total flooding systems. Strainers shall be installed ahead of small-orifice nozzles to prevent clogging.

Discharge nozzles shall be permanently marked to identify the nozzle and to show the equivalent single orifice diameter regardless of shape and number of orifices.

Piping shall be concealed to the maximum extent possible. Piping shall be inspected, tested, and approved before being concealed.

Joint compound for pipe threads shall be pipe cement and oil or graphite and oil.

Pipe hangers and supports shall be MSS SP-58 and MSS SP-69, adjustable type, zinc-coated. Spacing shall be as follows:

Nominal Pipe Size (inches)	Maximum Spacing (feet)
1 and under	7
1.25	8

Nominal Pipe Size (inches)	Maximum Spacing (feet)
1.5	9
2	10
2.5	11
3	12
3.5	13
4	14
5	15
6	16

Nominal Pipe Size (DN)	Maximum Spacing (millimeter)
15 and under	2130
32	2440
40	2740
50	3050
65	3350
80	3660
90	3960
100	4270
125	4570
150	4880

#### 2.2.2 Pipe Sleeves

Pipe sleeves shall be provided where piping passes through masonry or concrete walls, floors, roofs, and partitions. Sleeves in outside walls below and above grade, in floor, or in roof slabs, shall be Schedule 40 zinc-coated steel pipe. Sleeves in partitions shall be zinc-coated sheet steel having a nominal weight of not less than 0.90 pound per square foot 4.4 kilogram per square meter. Space between piping and the sleeve shall be not less than 0.25 inch 6 millimeter. Sleeves shall be placed securely in proper position and location during construction. Sleeves shall be of sufficient length to pass through the entire thickness of walls, partitions, or slabs. Sleeves shall extend 2 inches 50 millimeter above

finished floor slabs. Space between the pipe and sleeve shall be packed with insulation and both ends of the sleeve shall be calked with plastic waterproof cement.

### 2.2.3 Escutcheons

Approved-type escutcheons shall be provided for piping passing through floors, walls, and ceilings. Escutcheons shall be one-piece or split-type and, where pipe passes through finished ceilings, shall be chrome-plated. Other escutcheons shall be of steel or cast iron, with aluminum paint finish. Escutcheons shall be securely fastened in place with setscrews or other positive means.

## PART 3 EXECUTION

### 3.1 INSTALLATION

Materials and equipment shall be installed in accordance with NFPA 12.

Each system shall be provided complete and ready for operation.

Each system shall be provided with an approved pressure-relief device designed to operate between 2,400 and 3,000 psi 16.5 and 20.7 Megapascal and located between the storage cylinder manifolds and any normally close valve.

Listing of Product Installation shall be submitted for carbon dioxide fire-protection systems showing at least 5 installed units, similar to those proposed, that have been in successful service for a minimum period of 5 years. List shall include purchaser, address of installation, service organization, and date of installation.

#### 3.1.1 System Control

##### 3.1.1.1 Controls

\*\*\*\*\*  
**NOTE: Select control type.**  
\*\*\*\*\*

Actuating control system shall be [manual] [combination] [electric]  
[pneumatic] [mechanical pull cable].

##### 3.1.1.2 Control Stations for Underfloor Flooding Systems

Actuation stations for underfloor flooding systems shall be provided at the principal exits from the protected area. A separate actuation shall be provided for the main supply and reserve supply of carbon dioxide at each location.

##### 3.1.1.3 Pressure-Operated Fire Alarm Switch

A pressure-operated switch shall be provided to actuate the building interior fire alarm system upon the discharge of gas into the carbon

dioxide system piping for each separate system.

#### 3.1.1.4 Pressure-Operated Equipment Switch

A pressure-operated switch shall be provided to automatically shut down the air handling equipment serving the protected space upon the discharge of gas into the carbon dioxide system piping for each separate system.

#### 3.1.1.5 Suppression System Safing/Disconnect Switch

Both conductors of the solenoid/actuator/electric release head circuitry shall be Class B wired, connected in series to a Best Lock Switch No. 1W7D2 (DPST), such that opening the switch interrupts both conductors. Switch shall be installed in a weatherproof enclosure outside the primary entrance door to the facility. A sign shall explicitly indicate its purpose as "CARBON DIOXIDE SYSTEM SAFING SWITCH".

#### 3.1.1.6 Control Panel

Carbon dioxide control panel shall be provided for complete electrical supervision of actuating circuitry in accordance with NFPA 72. A modular type panel in a flush- or surface-mounted steel cabinet with hinged door and cylinder lock shall be installed. Control panel shall be a neat, compact, factory-wired assembly containing the parts and equipment required to provide specified operating and supervisory functions of the system. A ground fault condition that prevents the required operation of the system or a single break in any of the actuating circuits shall result in the activation of a system trouble signal. Loss of ac power shall also result in the operation of the system trouble signal.

### 3.1.2 System Power

#### 3.1.2.1 Primary Supply

System power shall be 120-volt, 60-hertz service, transformed through a two-winding isolation-type transformer and rectified to 24 volts dc for operating trouble signal and actuating circuits. A secondary dc power supply shall be provided for operation of the system if the ac power fails. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic. Trouble lights shall be located on the door of the cabinet. Cabinet shall be finished on the inside and outside in red enamel with prominent rigid plastic or metal identification plates attached.

#### 3.1.2.2 Secondary Supply

Secondary power supply shall include [nickel cadmium] [lead calcium] [sealed lead acid] batteries and charger. Dry cell batteries shall not be used. Batteries shall be housed in a well-constructed steel cabinet with cylinder lock.

#### 3.1.2.3 Storage Batteries

Batteries shall be of the proper ampere-hour capacity to operate the system

under supervisory conditions for 24 hours. Calculations substantiating the battery capacity shall be provided.

#### 3.1.2.4 Battery Charger

Battery charger shall provide completely automatic high/low charging rate capable of recovery of the batteries from full discharge to full charge in 24 hours or less. An ammeter showing rate of charge and a voltmeter to indicate state of battery charge shall be provided. A red pilot light shall indicate when batteries are manually placed on a high rate of charge, if a high-rate switch is provided.

#### 3.1.3 Electrical Work

Electrical work is specified in Section 13852, FIRE-ALARM SYSTEMS.

#### 3.1.4 Operating Instructions

Operating instructions shall be provided at each remote control station. Instructions shall clearly indicate necessary steps for the operation of the system.

Contractor shall submit [6] [\_\_\_\_\_] copies of the Operation and Maintenance Manuals 30 days prior to testing the carbon dioxide fire-protection systems. Data shall be updated and resubmitted for final approval no later than 30 days prior to contract completion.

Operating Instructions shall be submitted for carbon dioxide fire-protection systems consisting of raised or embossed white letters on red rigid plastic or enameled steel background and shall be of adequate size to permit them to be easily read.

#### 3.1.5 Field Painting

Painting of the system shall be in accordance with Section 09920, ARCHITECTURAL PAINTING.

### 3.2 FIELD QUALITY CONTROL

Testing to determine conformance with the requirements shall be conducted in the presence of the Contracting Officer.

#### 3.2.1 Preliminary Tests

Pressure tests and system tests shall be performed and recorded.

Each piping system shall be tested pneumatically at 150 pounds per square inch gage 1034 kilopascal and shall show no leakage or reduction in gage pressure after 2 hours. Upon completion and before final acceptance of the work, each piping system shall be tested by discharging a minimum of one 75-pound 34 kilogram high-pressure cylinders of carbon dioxide to demonstrate the reliability and proper functioning of pressure-operated switches and the discharge of carbon dioxide gas from each system discharge nozzle. Remote control stations, and all other components, supporting

elements and accessories shall be tested individually to demonstrate proper functioning. At the completion of tests and corrections, a signed and dated certificate shall be submitted to the Contracting Officer attesting to the satisfactory completion of all testing and that the system is in operating condition.

A written Request for Inspection and Test shall be submitted to the Contracting Officer for carbon dioxide fire-protection systems.

#### 3.2.2 Formal Tests

At a time to which the Government has agreed, the Contracting Officer and Government Fire Protection Engineer will witness formal tests and approve systems before they are accepted. An experienced technician regularly employed by the system installer shall be present during the inspection. At this inspection any or all of the required tests shall be repeated as directed by the Contracting Officer. Carbon dioxide, instruments, personnel, appliances, and equipment for testing shall be furnished by the Contractor at his expense.

#### 3.2.3 Manufacturer's Representative

An experienced manufacturer's field engineer shall be provided to supervise installation and testing of the system.

-- End of Section --